

**WHAT IS CLAIMED IS:**

1           1.       A method of negotiating point-to-point protocol (PPP), the method  
2 comprising:  
3           receiving a first configuration request packet at a first network element for a  
4           network connection from a second network element;  
5           responding with a first packet; and  
6           if a first response to said first packet is expected by said first network element,  
7           determining expected contents of said first response, and  
8           if said expected contents of said first response to said first packet  
9           require a response,  
10           responding with a second packet before receiving said first  
11           response.

1           2.       The method of claim 1, further comprising:  
2           sending a second configuration packet to said second network element.

3           3.       The method of claim 1, further comprising:  
4           if said first configuration request packet includes at least one unsupported  
5           option,  
6           responding with a configuration reject packet.

1           4.       The method of claim 3, further comprising:  
2           if said first configuration request packet includes at least one supported option  
3           having at least one unsupported value,  
4           responding with at least one configuration-NAK packet for said  
5           supported option having at least one unsupported value.

1           5.       The method of claim 4, wherein said configuration-NAK packet  
2 includes at least one suggested supported value for said supported option having at  
3 least one unsupported value.

1           6.     The method of claim 4, further comprising:  
2           responding with a first configuration-ACK packet having said supported  
3           option with said suggested supported value before receiving a response  
4           to said configuration-NAK packet.

1           7.     The method of claim 6, further comprising:  
2           starting a re-send timer.

1           8.     The method of claim 7, wherein a value of said re-send timer is  
2           dynamically determined according to a network traffic condition.

1           9.     The method of claim 7, further comprising:  
2           setting a state of said network connection to 'ACK-sent' after sending said  
3           first configuration-ACK packet.

1           10.    The method of claim 7, further comprising:  
2           setting said state of said network connection to 'open' after sending said first  
3           configuration-ACK packet.

1           11.    The method of claim 8, further comprising:  
2           if said re-send timer expires before a response to said second configuration  
3           request packet is received,  
4           re-sending said first configuration-ACK packet,  
5           restarting said re-send timer, and  
6           repeating said steps of re-sending and restarting until said response to  
7           said second configuration request packet is received.

1           12.    The method of claim 11, further comprising:  
2           if said response to said second configuration request packet is received,  
3           analyzing said response to said second configuration request packet.

1        13.    The method of claim 12, further comprising:  
 2        if said response to said second configuration request packet is a second  
 3                configuration-ACK packet,  
 4                setting said state of said network connection to 'open', and  
 5                discarding any further responses.

1        14.    The method of claim 12, further comprising:  
 2        if said response to said second configuration request packet is not said second  
 3                configuration-ACK packet,  
 4                resetting said state of said network connection, and  
 5                initiating conventional PPP negotiation.

1        15.    The method of claim 10, further comprising:  
 2        if said re-send timer expires before said response to said second configuration  
 3                request packet is received,  
 4                re-sending said first configuration-ACK packet,  
 5                resetting said state of said network connection to 'ACK-sent',  
 6                restarting said re-send timer, and  
 7                repeating said steps of re-sending and restarting until said response to  
 8                said second configuration request packet is received.

1        16.    The method of claim 15, further comprising:  
 2        if said response to said second configuration request packet is received,  
 3                analyzing said response to said second configuration request packet.

1        17.    The method of claim 16, further comprising:  
 2        if said response to said second configuration request packet is said second  
 3                configuration-ACK packet,  
 4                determining said state of said network connection, and  
 5                if said state of said network connection is not set to 'open',  
 6                setting said state of said network connection to 'open'.

1 18. The method of claim 17, further comprising:  
2 discarding any further responses.

1 19. The method of claim 16, further comprising:  
2 if said response to said second configuration request packet is not said second  
3 configuration-ACK packet,  
4 resetting said state of said network connection.

1 20. A network element comprising:  
2 means for receiving a first configuration request packet at a first network  
3 element for a network connection from a second network element;  
4 means for responding with a first packet;  
5 means for determining expected contents of said first response if a first  
6 response to said first packet is expected by said first network element;  
7 and  
8 means for responding with a second packet before receiving said first response  
9 if said expected contents of said first response to said first packet  
10 require a response.

1 21. The network element of claim 20, further comprising:  
2 means for sending a second configuration packet to said second network  
3 element.

4 22. The network element of claim 20, further comprising:  
5 means for responding with a configuration reject packet if said first  
6 configuration request packet includes at least one unsupported option.

1 23. The network element of claim 22, further comprising:  
2 means for responding with at least one configuration-NAK packet for said  
3 supported option having at least one unsupported value if said first  
4 configuration request packet includes at least one supported option  
5 having at least one unsupported value.

1           24.     The network element of claim 23, wherein said configuration-NAK  
2     packet includes at least one suggested supported value for said supported option  
3     having at least one unsupported value.

1           25.     The network element of claim 23, further comprising:  
2     means for responding with a first configuration-ACK packet having said  
3             supported option with said suggested supported value before receiving  
4     a response to said configuration-NAK packet.

1           26.     The network element of claim 25, further comprising:  
2     means for starting a re-send timer.

1           27.     The network element of claim 26, wherein a value of said re-send  
2     timer is dynamically determined according to a network traffic condition.

1           28.     The network element of claim 26, further comprising:  
2     means for setting a state of said network connection to 'ACK-sent' after  
3     sending said first configuration-ACK packet.

1           29.     The network element of claim 26, further comprising:  
2     means for setting said state of said network connection to 'open' after sending  
3     said first configuration-ACK packet.

1           30.     The network element of claim 27, further comprising:  
2     means for re-sending said first configuration-ACK packet if said re-send timer  
3             expires before a response to said second configuration request packet is  
4     received;  
5     means for restarting said re-send timer if said re-send timer expires before a  
6             response to said second configuration request packet is received; and  
7     means for repeating said steps of re-sending and restarting until said response  
8             to said second configuration request packet is received if said re-send  
9     timer expires before a response to said second configuration request  
10    packet is received.

1        31.     The network element of claim 30, further comprising:  
2        means for analyzing said response to said second configuration request packet  
3        if said response to said second configuration request packet is received.

1        32.     The network element of claim 31, further comprising:  
2        means for setting said state of said network connection to 'open' if said  
3        response to said second configuration request packet is a second  
4        configuration-ACK packet; and  
5        means for discarding any further responses if said response to said second  
6        configuration request packet is a second configuration-ACK packet.

1        33.     The network element of claim 31, further comprising:  
2        means for resetting said state of said network connection if said response to  
3        said second configuration request packet is not said second  
4        configuration-ACK packet; and  
5        means for initiating conventional PPP negotiation if said response to said  
6        second configuration request packet is not said second configuration-  
7        ACK packet.

1        34.     The network element of claim 29, further comprising:  
2        means for re-sending said first configuration-ACK packet if said re-send timer  
3        expires before said response to said second configuration request  
4        packet is received;  
5        means for resetting said state of said network connection to 'ACK-sent' if said  
6        re-send timer expires before said response to said second configuration  
7        request packet is received;  
8        means for restarting said re-send timer if said re-send timer expires before said  
9        response to said second configuration request packet is received; and  
10       means for repeating said steps of re-sending and restarting until said response  
11       to said second configuration request packet is received if said re-send  
12       timer expires before said response to said second configuration request  
13       packet is received.

1        35.    The network element of claim 34, further comprising:  
 2        means for analyzing said response to said second configuration request packet  
 3        if said response to said second configuration request packet is received.

1        36.    The network element of claim 35, further comprising:  
 2        means for determining said state of said network connection if said response to  
 3        said second configuration request packet is said second configuration-  
 4        ACK packet; and  
 5        means for setting said state of said network connection to 'open' if said state  
 6        of said network connection is not set to 'open'.

1        37.    The network element of claim 36, further comprising:  
 2        means for discarding any further responses.

1        38.    The network element of claim 16, further comprising:  
 2        means for resetting said state of said network connection if said response to  
 3        said second configuration request packet is not said second  
 4        configuration-ACK packet.

1        39.    A network element comprising:  
 2        a processor; and  
 3        a network interface coupled to said processor, wherein said processor is  
 4        configured to  
 5        receive a first configuration request packet at a first network element  
 6        for a network connection from a second network element,  
 7        respond with a first packet, and  
 8        if a first response to said first packet is expected by said first network  
 9        element,  
 10        determine expected contents of said first response, and  
 11        if said expected contents of said first response to said first  
 12        packet require a response,

13                                    respond with a second packet before receiving said first  
14                                    response.

1            40.    The network element of claim 39, wherein said processor is further  
2 configured to  
3            sending a second configuration packet to said second network element.

4            41.    The network element of claim 39, wherein said processor is further  
5 configured to  
6            respond with a configuration reject packet if said first configuration request  
7            packet includes at least one unsupported option.

1            42.    The network element of claim 3, wherein said processor is further  
2 configured to  
3            respond with at least one configuration-NAK packet for said supported option  
4            having at least one unsupported value if said first configuration request  
5            packet includes at least one supported option having at least one  
6            unsupported value.

1            43.    The network element of claim 42, wherein said configuration-NAK  
2 packet includes at least one suggested supported value for said supported option  
3            having at least one unsupported value.

1            44.    The network element of claim 42, wherein said processor is further  
2 configured to  
3            respond with a first configuration-ACK packet having said supported option  
4            with said suggested supported value before receiving a response to said  
5            configuration-NAK packet.

1            45.    The network element of claim 6, wherein said processor is further  
2 configured to  
3            start a re-send timer.



1           46.     The network element of claim 45, wherein a value of said re-send  
2 timer is dynamically determined according to a network traffic condition.

1           47.     The network element of claim 45, wherein said processor is further  
2 configured to  
3           set a state of said network connection to 'ACK-sent' after sending said first  
4           configuration-ACK packet.

1           48.     The network element of claim 45, wherein said processor is further  
2 configured to  
3           set said state of said network connection to 'open' after sending said first  
4           configuration-ACK packet.

1           49.     The network element of claim 46, wherein said processor is further  
2 configured to  
3           re-send said first configuration-ACK packet if said re-send timer expires  
4           before a response to said second configuration request packet is  
5           received;  
6           restart said re-send timer if said re-send timer expires before a response to said  
7           second configuration request packet is received; and  
8           repeat said steps of re-sending and restarting until said response to said second  
9           configuration request packet is received if said re-send timer expires  
10          before a response to said second configuration request packet is  
11          received.

1           50.     The network element of claim 49, wherein said processor is further  
2 configured to  
3           analyze said response to said second configuration request packet if said  
4           response to said second configuration request packet is received.

1           51.    The network element of claim 50, wherein said processor is further  
2 configured to  
3           set said state of said network connection to 'open' if said response to said  
4           second configuration request packet is a second configuration-ACK  
5           packet; and  
6           discard any further responses if said response to said second configuration  
7           request packet is a second configuration-ACK packet.

1           52.    The network element of claim 50, wherein said processor is further  
2 configured to  
3           reset said state of said network connection if said response to said second  
4           configuration request packet is not said second configuration-ACK  
5           packet; and  
6           initiate conventional PPP negotiation if said response to said second  
7           configuration request packet is not said second configuration-ACK  
8           packet.

1           53.    The network element of claim 48, wherein said processor is further  
2 configured to  
3           re-send said first configuration-ACK packet if said re-send timer expires  
4           before said response to said second configuration request packet is  
5           received;  
6           reset said state of said network connection to 'ACK-sent' if said re-send timer  
7           expires before said response to said second configuration request  
8           packet is received;  
9           restart said re-send timer if said re-send timer expires before said response to  
10          said second configuration request packet is received; and  
11          repeat said steps of re-sending and restarting until said response to said second  
12          configuration request packet is received if said re-send timer expires  
13          before said response to said second configuration request packet is  
14          received.

1           54.     The network element of claim 53, wherein said processor is further  
2 configured to  
3           analyze said response to said second configuration request packet if said  
4           response to said second configuration request packet is received.

1           55.     The network element of claim 54, wherein said processor is further  
2 configured to  
3           determine said state of said network connection if said response to said second  
4           configuration request packet is said second configuration-ACK packet;  
5           and  
6           set said state of said network connection to 'open' if said state of said network  
7           connection is not set to 'open'.

1           56.     The network element of claim 55, wherein said processor is further  
2 configured to  
3           discard any further responses.

1           57.     The network element of claim 54, wherein said processor is further  
2 configured to  
3           reset said state of said network connection if said response to said second  
4           configuration request packet is not said second configuration-ACK  
5           packet.

1           58.     A computer program product for negotiating point-to-point protocol  
2 (PPP), encoded in computer readable media, said program product comprising a set of  
3 instructions executable on a computer system, wherein said set of instructions  
4 configured to  
5           receive a first configuration request packet at a first network element for a  
6           network connection from a second network element;  
7           respond with a first packet; and  
8           if a first response to said first packet is expected by said first network element,  
9           determine expected contents of said first response, and  
10          if said expected contents of said first response to said first packet  
11          require a response,  
12          respond with a second packet before receiving said first  
13          response.

1           59.     The computer program product of claim 58, wherein said set of  
2 instructions is further configured to  
3           send a second configuration packet to said second network element.

1           60.     The computer program product of claim 58, wherein said set of  
2 instructions is further configured to  
3           if said first configuration request packet includes at least one unsupported  
4           option,  
5           respond with a configuration reject packet.

1           61.     The computer program product of claim 60, wherein said set of  
2 instructions is further configured to  
3           if said first configuration request packet includes at least one supported option  
4           having at least one unsupported value,  
5           respond with at least one configuration-NAK packet for said supported  
6           option having at least one unsupported value.

1           62.    The computer program product of claim 61, wherein said  
2 configuration-NAK packet includes at least one suggested supported value for said  
3 supported option having at least one unsupported value.

1           63.    The computer program product of claim 61, wherein said set of  
2 instructions is further configured to  
3 respond with a first configuration-ACK packet having said supported option  
4 with said suggested supported value before receiving a response to said  
5 configuration-NAK packet.

1           64.    The computer program product of claim 63, wherein said set of  
2 instructions is further configured to  
3 start a re-send timer.

1           65.    The computer program product of claim 64, wherein a value of said re-  
2 send timer is dynamically determined according to a network traffic condition.

1           66.    The computer program product of claim 64, wherein said set of  
2 instructions is further configured to  
3 set a state of said network connection to 'ACK-sent' after sending said first  
4 configuration-ACK packet.

1           67.    The computer program product of claim 64, wherein said set of  
2 instructions is further configured to  
3 set said state of said network connection to 'open' after sending said first  
4 configuration-ACK packet.

1           68.    The computer program product of claim 65, wherein said set of  
2 instructions is further configured to  
3           if said re-send timer expires before a response to said second configuration  
4           request packet is received,  
5           re-send said first configuration-ACK packet,  
6           restart said re-send timer, and  
7           repeat said steps of re-sending and restarting until said response to said  
8           second configuration request packet is received.

1           69.    The computer program product of claim 68, wherein said set of  
2 instructions is further configured to  
3           if said response to said second configuration request packet is received,  
4           analyze said response to said second configuration request packet.

1           70.    The computer program product of claim 69, wherein said set of  
2 instructions is further configured to  
3           if said response to said second configuration request packet is a second  
4           configuration-ACK packet,  
5           set said state of said network connection to 'open', and  
6           discard any further responses.

1           71.    The computer program product of claim 69, wherein said set of  
2 instructions is further configured to  
3           if said response to said second configuration request packet is not said second  
4           configuration-ACK packet,  
5           reset said state of said network connection, and  
6           initiate conventional PPP negotiation.

1           72.    The computer program product of claim 67, wherein said set of  
2 instructions is further configured to  
3           if said re-send timer expires before said response to said second configuration  
4           request packet is received,  
5           re-send said first configuration-ACK packet,  
6           reset said state of said network connection to 'ACK-sent',  
7           restart said re-send timer, and  
8           repeat said steps of re-sending and restarting until said response to said  
9           second configuration request packet is received.

1           73.    The computer program product of claim 72, wherein said set of  
2 instructions is further configured to  
3           if said response to said second configuration request packet is received,  
4           analyze said response to said second configuration request packet.

1           74.    The computer program product of claim 73, wherein said set of  
2 instructions is further configured to  
3           if said response to said second configuration request packet is said second  
4           configuration-ACK packet,  
5           determine said state of said network connection, and  
6           if said state of said network connection is not set to 'open',  
7           set said state of said network connection to 'open'.

1           75.    The computer program product of claim 74, wherein said set of  
2 instructions is further configured to  
3           discard any further responses.

1           76.    The computer program product of claim 73, wherein said set of  
2 instructions is further configured to  
3           if said response to said second configuration request packet is not said second  
4           configuration-ACK packet,  
5           reset said state of said network connection.